Community Air Quality Monitoring: Special Studies

Fruitvale /Oakland

Lockwood Elementary School

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California Environmental Protection Agency
Air Resources Board

Executive Summary

This report presents the final results from an 18-month special air quality monitoring study from November 2001 through April 2003, in the community of Fruitvale in Oakland. The California Air Resources Board (ARB) conducted the study as part of a larger statewide evaluation of the adequacy of the State's air quality monitoring network as required by the Children's Environmental Health Protection Act (Escutia, Senate Bill 25, 1999 (SB 25)).

Contents

The ARB selected Fruitvale, a community in the San Francisco Bay Area (Bay Area), to investigate the impact of traffic and other industrial sources on children's exposure to air pollution. Fruitvale lies between two major East Bay freeways, and is surrounded by many industrial sources in the vicinity of the Port of Oakland, Oakland International Airport, and numerous distribution centers and transportation-related businesses.

For the study, Lockwood Elementary School was chosen as the air-monitoring site because it is impacted by several categories of pollutant emissions and because of the large school population in the area. Lockwood Elementary School is located just a few miles south of downtown Oakland. Data from Fruitvale was compared to data from long-term monitoring sites in Oakland and Fremont.

Average levels of criteria air pollutants in Fruitvale are comparable to measurements from the nearest long-term monitoring sites in the Bay Area. Fruitvale, like many other areas in the Bay Area, exceeds the State standard for particulate matter (PM_{10}). The State PM_{10} standard (50 $\mu g/m^3$) was exceeded on two occasions at the Fruitvale site. PM_{10} data at Fruitvale was invalidated from (March 2003 – April 2003) due to an air monitoring instrument problem; as a result, there is no available data for that two month time period. All of the PM2.5 monitoring data collected in the Fruitvale study were invalidated due to an instrument problem. While standards for particulate matter have not been achieved, programs are in place for reducing levels of this pollutant.

The Fruitvale, Oakland, and Fremont sites, like many other areas in the Bay Area, didn't exceed the State standards for carbon monoxide (CO). The Fruitvale and Oakland sites didn't exceed any of the State ozone standards. The Fremont site did exceed the State one-hour ozone standard on three occasions. The State nitrogen dioxide (NO_2) standard was not exceeded during the study.

When assessing the impact of toxic air pollution, the study found that the cancer risk associated with air pollution in Fruitvale was comparable to the risk

measured in Fremont, but lower than the average risk Statewide. Benzene and 1,3-butadiene accounted for most of the calculated cancer risk in Fruitvale and Fremont. Because motor vehicles are the primary source of both these pollutants, heavy traffic near the two sites is probably the main source of these pollutants. Cancer risk estimates in this report did not include diesel particulate matter (diesel PM).

You can locate all of Fruitvale's air monitoring data at: (http://www.arb.ca.gov/ch/aq_result/fruitvale/fruitvale.htm)

The air monitoring conducted in Fruitvale was part of a larger study to evaluate the statewide air quality monitoring network. This evaluation is contained in a report titled *The Assessment of California's Statewide Air Monitoring Network* (Adequacy Report). The Adequacy Report was written before all of the 2001, 2002 and 2003 data from the Oakland and Fremont sites used in this report were available. As a result, the analyses and findings relating to Fruitvale in the Adequacy Report may differ somewhat from those contained in this report.

Introduction

Investigating the relationship of air pollution to children's health is an ongoing priority at the ARB. The ARB has sponsored many studies on the health effects of children and their exposure to air contaminants. These and other studies indicate that children:

- are more vulnerable to environmental contaminants than adults;
- have higher exposure compared to adults relative to their body size;
- breathe more air on a comparable scale; and
- tend to be more active and breathe more rapidly than adults — therefore taking in larger doses of air contaminants.

In the long term, exposure to air pollutants can adversely affect the development of children's lungs, heart, and immune systems.

The Children's Environmental Health Protection Act

In recognition of children's vulnerability to air pollution, the California Legislature enacted the Children's Environmental Health Protection Act (Escutia, Senate Bill 25, 1999 (SB 25)). This legislation directed the ARB to take additional steps to ensure that the State's air pollution programs are protective of children's health. These steps include:

- a review of air quality standards to ensure children are protected;
- an evaluation of the adequacy of the current outdoor ambient air monitoring network to gather data necessary to determine children's exposure, including special monitoring studies in six communities in air pollution nonattainment areas around the State; and
- the review and development, where needed, of air toxic control measures to protect children's health.

SB 25 also requires the Office of Environmental Health Hazard Assessment (OEHHA) to identify those pollutants that are most harmful to children. In 2001, OEHHA released the final report, *Prioritization of Toxic Air Contaminants – SB25* (http://www.oehha.ca.gov/air/toxic_contaminants/SB25finalreport.htm). ARB must then review affected airborne toxic control measures (ATCMs) for these toxic air contaminants to ensure they adequately protect infants and children. ARB's ATCM efforts are ongoing. The focus of this report is on air monitoring results.

Fruitvale Air Quality Monitoring Study

This report presents the final results from a special air quality monitoring study in the community of Fruitvale in the Bay Area. The ARB conducted the air monitoring in Fruitvale, which began in November 2001 and ended in April 2003, as one of six special community air quality monitoring studies required by SB 25.

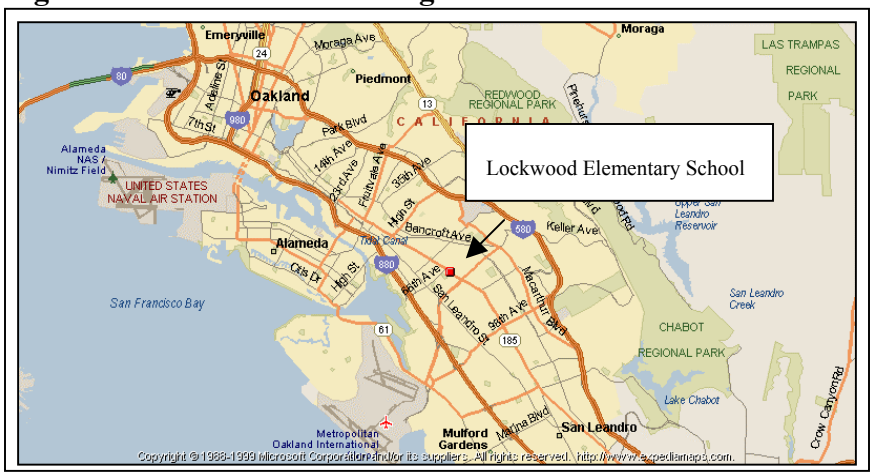
The Fruitvale study was also part of a larger study to evaluate the adequacy of the statewide air monitoring network. This evaluation is contained in a report titled *The Assessment of California's Statewide Air Monitoring Network* (Adequacy Report) (http://www.arb.ca.gov/ch/programs/sb25/adequacy.htm). The Adequacy Report was written before all of the 2001, 2002 and 2003 data from the Fremont and Oakland sites used in this report were available. As a result, the analyses and findings relating to Fruitvale in the Adequacy Report may differ somewhat from those contained in this report.

Description of the Air Monitoring Study

Site Selection

The ARB selected Fruitvale as a study site to investigate the impact of industrial sources and mobile source emissions on children's exposure to air pollution and to evaluate the ability of the State's permanent monitoring network to gauge that exposure. SB 25 required limited-term monitoring in six communities around the State. The air pollution monitors were placed at locations where children live, learn, and play. The other five SB 25 sites are: Barrio Logan (San Diego), Boyle Heights, Wilmington (Los Angeles), Crockett, and Fresno. Fruitvale lies between two major East Bay freeways that are a significant source of vehicular emissions. The area is downwind of several industrial operations that are sources of criteria and air toxic emissions. The Oakland International Airport, which is less than five miles from Fruitvale, is a source of aircraft and ground vehicle emissions. The ARB conducted air quality monitoring at Lockwood Elementary School, which is part of an educational

Figure 1. Fruitvale Monitoring Site



complex that includes Havenscourt Middle School and a child development center, with a total enrollment of about 1,800 children (Figure 1).

Pollutants Sampled

Outdoor air samples for over 50 air pollutants were collected in Fruitvale during an 18-month period that began in November 2001 and ended in April 2003. The sampled pollutants included both toxic air pollutants and others known as "criteria pollutants" that contribute to smog and particulate matter. Table 1 lists the key air pollutants measured and reviewed for this report. The levels of the remainder of the other pollutants measured were very low or not detectable. Particulate matter from diesel-powered engines, an important contributor to cancer risk, was not directly measured as part of this study. Monitoring methods for diesel particulates and some other air pollutants that may cause adverse health effects are still under development.

Table 1. Key Air Pollutants Monitored in Fruitvale

Fruitvale	
Toxic Air Pollutants	**Criteria Pollutants**
1,3-butadiene	Particulate matter
Benzene	Ozone
Acetaldehyde	Carbon monoxide
Formaldehyde	Oxides of nitrogen
Perchloroethylene	
Carbon tetrachloride	
Methylene chloride	
Para-dichlorobenzene	
Hexavalent chromium	
Polycyclic aromatic hydrocarbons	
Arsenic	
Lead	
Manganese	
Nickel	

Toxic air pollutants are known or suspected to cause cancer or other serious illnesses. Ozone and particulate matter are "criteria pollutants" for which health-based criteria or air quality standards have been established. The standards establish the levels above which a criteria pollutant may cause adverse health effects in humans.

California's Air Monitoring Network

The State's ambient air quality monitoring network is a key tool in measuring air quality in California and for determining the public's exposure to air pollution. The data collected by this network of over 250 air quality monitoring sites are used to:

- track progress towards clean air;
- help determine exposures to sensitive populations, such as children and the elderly;
- help evaluate which pollutants in the outdoor air present the greatest hazards and thus help the ARB establish priorities for control;
- guide the announcement of "Spare the Air" days and other potentially hazardous conditions; and
- investigate the relationships between air pollution and children's health.

Fruitvale Data Compared to Long-term Monitoring Sites

Air quality measurements from Fruitvale were compared to measurements from two of the closest permanent air quality monitoring sites: Fremont and Oakland (see Figure 2). Fremont (Chapel Way) is 23 miles south of Fruitvale, about one-half of a mile from I-680. Oakland (Alice Street) is 6 miles north of Fruitvale and about one-third of a mile from Interstate 880.

Figure 2. Fruitvale and Long-term Monitoring Sites

Air Monitoring Results for Criteria Pollutants

Criteria pollutants can cause lung damage, heart problems, and in some cases, premature deaths. Based on the health and environmental impacts of these pollutants, federal and State air quality agencies have identified safety thresholds and established air quality standards for these pollutants to protect public health.

Criteria pollutant
An air pollutant with established safety thresholds and standards.

Five criteria pollutants — particulate matter that is 10 microns in diameter and smaller (PM_{10}), particulate matter that is 2.5 microns in diameter and smaller ($PM_{2.5}$), ozone, carbon monoxide (CO), and oxides of nitrogen (NOx), — were measured in Fruitvale. These pollutants are also routinely measured at the Fremont (Chapel Way) long-term monitoring site. The Oakland (Alice Street) site measures only carbon monoxide and ozone.

Particulate Matter (PM_{10})

The Bay Area region currently meets the federal air quality standard for particulate matter (PM_{10}). The small size of PM_{10} allows the pollutant to reach deep in the lungs where it may be deposited and cause adverse health effects. Major sources of PM_{10} in California include motor vehicles, area-wide sources such as dust from construction and landfills, wood-burning stoves and fireplaces, wildfires and brush/waste burning, and industrial facilities. PM_{10} can also be formed in the atmosphere through chemical reactions between other air pollutants.

From 1990 to 2000, overall PM_{10} emissions in California increased as the population of California rose. This was primarily the result of increased fugitive dust from paved and unpaved roads, reflecting the growth of vehicle travel in California. However, emissions of diesel particulate matter, which poses the most significant health risk, dropped 40% from 1990 to 2000 due to stricter engine emission standards and the introduction of cleaner fuel.

Table 2 summarizes PM_{10} levels at Fruitvale and Fremont over a 16-month period, from November 2001 through February 2003. PM_{10} data at Fruitvale was invalidated March 2003 and April 2003, due to an air monitoring instrument problem; as a result there is no available data for that period of time. It is customary to study air quality for a year or more to account for seasonal variations. Unlike the other criteria pollutants, which are measured continuously, PM_{10} is usually measured over a 24-hour period once every six days.

Table 2. Particulate Matter (PM_{10}) from November 2001 through February 2003 (1)

Location	Average (2)	Maximum (3)	Number of Days Above State Standard (4)
Fruitvale (Lockwood)	24	70	2 out of 70 days
Fremont (Chapel Way)	20	52	1 out of 76 days

1. PM_{10} data at Fruitvale was invalidated March 2003 and April 2003, due to an air monitoring instrument problem; as a result there is no available data for that period of time.
2. Values are 24-hour average concentrations reported in units of micrograms per cubic meter (ug/m^3).
   - Average is defined as the average of all valid 24-hour samples collected at that location.
3. Maximum is defined as the highest 24-hour sample measured at that location.
4. Particulate matter standards –federal 24-hour average: 150 micrograms/m^3 (ug/m^3);
   State 24-hour average: 50 $ug/m.^3$

While the federal PM_{10} standard was not exceeded at either of these sites, the 24-hr State PM_{10} standard (50 $\mu g/m^3$) was exceeded at both sites on December 4, 2002. The second exceedance recorded at Fruitvale was measured on November 28, 2002 (Thanksgiving Day). This suggests that something out of the ordinary happened that day such as a large amount of people using their fireplaces on Thanksgiving Day, or some other unusual condition. Overall, the PM_{10} levels and the frequency of State standard exceedances were comparable at the Fruitvale and Fremont monitoring sites for the period.

PM2.5

During the study, we initially recorded unexpectedly high PM2.5 measurements at Fruitvale. We later found this was due to an improperly adjusted PM2.5 monitor. Because of this instrument problem, all of the PM2.5 monitoring data collected in the Fruitvale study were invalidated.

Ozone

Ozone is a product of the chemical reactions of nitrogen oxides and volatile organic compounds in the presence of sunlight and is a major contributor to smog. Near the earth's surface, ozone can cause breathing difficulties and even lung damage. Ground-level ozone can also damage vegetation, buildings, rubber, and plastics. Currently, large portions of the State do not meet the federal or State air quality standards for ozone. Due to favorable meteorological conditions, the Bay Area generally has lower ozone levels than other urban portions of the State, including the Sacramento and Los Angeles areas.

Table 3. Ozone from November 2001 through April 2003 [1]

Location	Average [2]	Maximum [3]	Number of Days Above State Standard [4]
Fruitvale (Lockwood)	34	84	0
Fremont (Chapel Way)	37	110	3
Oakland (Alice Street) [5]	26	61	0

1. Values are one-hour average concentrations reported in units of parts per billion (ppb).
2. Average is the average of all daily one-hour maximum concentrations measured at that location.
3. Maximum is the highest one-hour concentration measured at that location.
4. Ozone standards—federal 1 hour: 120 ppb, State 1 hour: 90 ppb.
5. Oakland (Alice Street) is missing data from 01/01/2002 through 03/31/2002.

As summarized in Table 3, the measured levels of ozone in Fruitvale during this study are comparable to those routinely measured in this part of Alameda County. Over a period of 18 months, from November 2001 through April 2003, the study found ozone levels above the State one-hour ozone standard (90 ppb) on three days in Fremont. There were no exceedances of the federal or State ozone standards in Fruitvale or Oakland.

California has adopted aggressive emission controls on motor vehicles and other sources. As a consequence, the ozone levels have decreased dramatically over the last two decades in the Bay Area. The ARB expects continued progress toward reducing ozone.

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless gas at room temperature. It is readily absorbed through the lungs into the blood, causing insufficient oxygen to reach the heart, brain, and other tissues. The resulting harm can be critical for people with heart disease, chronic lung diseases, and anemia as well as for unborn children.

CO is formed as a result of incomplete combustion of fuels and waste materials such as gasoline, diesel fuel, wood, and agricultural debris. Mobile sources generate most of the CO emissions in California. The contribution of industrial sources to overall CO emissions is small. Currently, CO levels in most areas of California are below the State standard, so CO is a diminishing problem in California.

As shown in Table 4, CO levels in Fruitvale appear to be slightly higher than at Fremont and Oakland, but were only a little over one half of the State standard. The higher values may reflect the higher traffic activity in the Fruitvale area. Much of the progress in reducing levels of CO is attributable to new motor vehicle emission controls and the introduction of cleaner fuels. The ARB expects further reductions of CO levels statewide.

Table 4. Carbon Monoxide from November 2001 through April 2003 (1)

Location	Average (2)	Maximum (3)	Number of Days Above State Standard (4)
Fruitvale (Lockwood)	1.2	5.1	0
Fremont (Chapel Way)	0.8	2.2	0
Oakland (Alice Street)	1.0	3.3	0

1. Values are 8-hour average concentrations reported in unites of parts per million (ppm)
2. Average is the average of all daily maximum 8-hour concentrations measured at that location
3. Maximum is the highest 8-hour average concentration measured at that location
4. Carbon monoxide standards: federal and State 8 hour: 9 ppm

Oxides of Nitrogen

Oxides of nitrogen (NO_x) contribute to the formation of ozone and particulate matter, both of which are major air pollutants that reach unhealthy levels in many areas of California. NO_x is emitted during the high-temperature combustion of fuels. On-road motor vehicles and other mobile sources currently contribute most of the NO_x emissions in California.

The two major types of oxides of nitrogen are nitric oxide (NO) and nitrogen dioxide (NO_2). Since the Bay Area and other areas of the State are currently attaining the State standard for NO_2, this report will discuss NO_x because it contributes to the formation of smog.

As shown in Table 5, Fruitvale's annual levels of NO_x are slightly higher than those measured at the Fremont site and probably reflect the impact of traffic in the area. The State NO_2 standard was not exceeded during the study.

Table 5. Oxides of Nitrogen [1] from November 2001 through April 2003

Location	Average [2]	Maximum [3]
Fruitvale (Lockwood)	117	381
Fremont (Chapel Way)	88	304

1. No federal or State standard has been established for NOx; the State standard for NO_2 (250 ppb for a one-hour average) was not exceeded during the study. Values are one-hour average concentrations of NOx reported in units of parts per billion (ppb).
2. Average is the average of all daily maximum one-hour average concentrations measured at that location.
3. Maximum is the highest one-hour average concentration measured at that location.

Statewide emissions of NO_x from on-road motor vehicles declined by more than 30 percent from 1990 to 2000 and are projected to decrease by an additional 40 percent between 2000 to 2010 due to stringent emission standards on new motor vehicles and the introduction of cleaner burning gasoline. Emissions from industrial sources have also decreased, largely because of a switch from fuel oil to natural gas and the implementation of combustion controls. However, the ARB continues to work toward reducing levels of NO_x due to its role in the formation of ozone and particulate matter.

Criteria Pollutant Monitoring Summary

Average levels of criteria air pollutants in Fruitvale are compared to measurements from the nearest long-term monitoring sites in the Bay Area. Fruitvale, like many other areas in the Bay Area, exceeds the State standard for PM_{10}. The State PM_{10} standard (50 $\mu g/m^3$) was exceeded at both Fruitvale and the Fremont site on December 4, 2002. The second exceedance recorded at Fruitvale was measured on November 28, 2002 (Thanksgiving Day). This suggests that something out of the ordinary happened that day such as a large amount of people using their fireplaces on Thanksgiving Day, or some other unusual condition. While standards for particulate matter have not been achieved, programs are in place for reducing levels of this pollutant.

Fruitvale, like many other areas in the Bay Area, didn't exceed the State standards for CO. The Fruitvale site didn't exceed any of the State ozone standards. The Fremont site did exceed the State one-hour ozone standard on three occasions. The State NO_2 standard was not exceeded during the study. You can locate all of Fruitvale's air monitoring data at: (http://www.arb.ca.gov/ch/aq_result/fruitvale/fruitvale.htm)

Air Monitoring Results for the Main Toxic Air Pollutants

Health Effects of Toxic Air Pollutants

Toxic air pollutants can cause adverse health effects, including cancer, asthma, respiratory problems, and other serious illnesses. Cancer risk estimates related to toxic air pollution represent the chance of excess cancer cases in one million people, assuming exposure over a 70-year lifetime.

Main Toxic Air Pollutants Monitored in Fruitvale

- Benzene
- 1,3-Butadiene
- Formaldehyde
- Acetaldehyde
- Perchlorethylene
- Carbon Tetrachloride
- Methylene Chloride
- Para-dichlorobenzene

Monitoring results indicate that the potential cancer risk in Fruitvale is mostly attributable to the main toxic air pollutants measured during the study: benzene, 1,3-butadiene, formaldehyde, acetaldehyde, perchlorethylene, carbon tetrachloride, methylene chloride and para-dichlorobenzene. This report only assesses the cancer risk posed by levels of eight of the approximately 40 toxic air pollutants measured during this study. Including the other toxic air pollutants measured at these sites does not significantly change the overall risk at each site nor does it change the overall relationship of cancer risk between sites.

These cancer risk estimates did not include diesel particulate matter (diesel PM). Diesel PM is believed to be the primary contributor to health risks from urban toxic air pollutants. The estimated average potential cancer risk from diesel PM in the Bay Area is 480 chances per million (based on year 2000 data). However, diesel PM was not measured as part of this study because a proven ambient method for measuring it is not currently available. The ARB is in the process of developing methods to measure diesel PM. California already has an aggressive program to reduce diesel PM emissions throughout the State. You can locate the ARB's diesel risk reduction plan by clicking on the link provided below.

(http://www.arb.ca.gov/diesel/documents/rrpapp.htm)

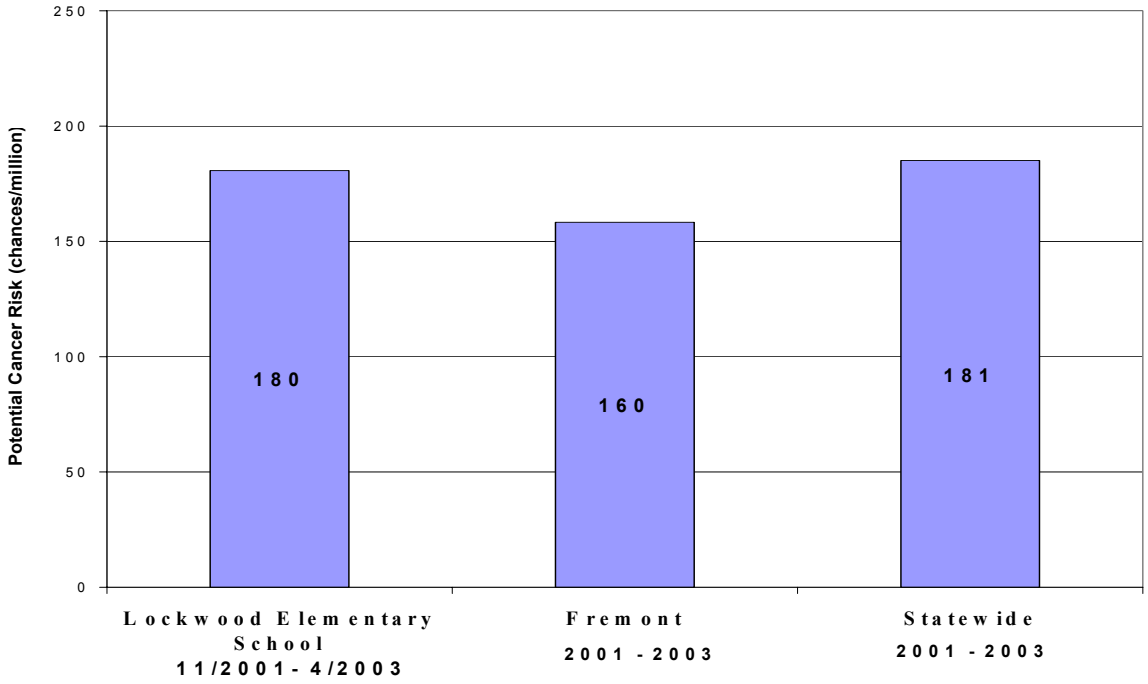
Cancer Risk Estimates for Pollutants in Fruitvale

To put the results from Fruitvale into perspective, ARB staff calculated estimates of potential cancer risk for the main toxic air pollutants in Fruitvale (November 2001 through April 2003) and Fremont (2001-2003), as seen in Figure 3. In addition, a calculated estimate of potential cancer risk on a statewide average (2001-2003) is included for comparison. Matched days were not available for comparison; therefore, comparisons were made relative to the overall averages between sites. As shown in Figure 3, potential cancer risk is higher at Fruitvale than the estimated toxic air pollutant cancer risk in Fremont. Fruitvale is similar to the statewide urban average.

The health risks estimates in this report are based on the best available scientific information. Sources of potential uncertainty in these estimates include the

unavailability of risk estimates for certain pollutants and limitations in scientific understanding of the pollutants' health effects. Furthermore, our analysis of health risks from toxic air pollutants focused on one possible adverse health effect, cancer, whereas these pollutants may also cause a variety of respiratory, reproductive, and other adverse health effects. However, measured levels of benzene, 1,3-butadiene, formaldehyde and acetaldehyde do not exceed thresholds established for non-cancer health effects.

Figure 3. Potential Cancer Risk for the Main Toxic Air Pollutants (1) (2)



1. Does not include estimate risk from diesel PM.
2. The potential risk estimates assume a lifetime exposure through breathing pathway only.

Table 6 shows how much each toxic pollutant contributes to the overall cancer risk shown in Figure 3. Data on matched days between Fruitvale and Fremont were not available during this study. Therefore, the following discussion of comparisons between toxic air pollutants is based on all of the data collected at Fruitvale (November 2001 through April 2003) and Fremont (2001-2003). The Fremont site was missing hexavalent chromium data for the entire study period, except for one day, so it could not be included in the results.

Table 6. Annual Average Levels of the Main Toxic Air Pollutants

		Fruitvale (Lockwood) (11/2001 - 4/2003)		Fremont (Chapel Way) (2001 – 2003)	
Pollutant	Risk Factor (1)	Average Concentration (2)	Cancer Risk (3)	Average Concentration (2)	Cancer Risk (3)
Benzene	93	0.62	57	0.47	43
1,3-butadiene	376	0.18	68	0.15	56
Formaldehyde	7	2.0	14	3.24	23
Acetaldehyde	5	0.68	4	0.79	4
Perchloroethylene	40	0.07	3	0.06	2
Carbon tetrachloride	264	0.09	23	0.08	21
Methylene chloride	3	0.23	1	0.23	1
Para-dichlorobenzene	66	0.15	10	0.15	10
Hexavalent chromium (4)	150	.12	18	N/A	N/A

1. Toxicity values for cancer causing air pollutants expressed in terms of risk per unit concentration of the air pollutant given in chances of cancer per million people.
2. Values are 24-hour average concentrations reported in units of parts per billion (ppb).
3. Cancer risk estimates are calculated as (risk factor * average concentration) = cancer risk. Cancer risk estimates represent the chance of excess cancer cases in one million people, assuming these people breathe the average level of the pollutant over a 70-year lifetime.
4. Summary of hexavalent chromium measured at Fruitvale:
   - 7 of the 83 samples of hexavalent chromium measured were above the limit of detection (LOD).
   - 76 samples of hexavalent chromium measured were below the LOD.
   - Samples below the LOD are set at .1 ppb.

Benzene, 1,3-Butadiene, Formaldehyde, and Acetaldehyde

While motor vehicles are the primary source of benzene, 1,3-butadiene, formaldehyde, and acetaldehyde, levels of these pollutants did not follow the same pattern at all sites.

Levels of benzene and 1,3-butadiene were higher at Fruitvale, than what was measured at the Fremont site. Since motor vehicles are the primary source of

both pollutants, heavy traffic near Fruitvale is probably the cause of the higher benzene and 1,3-butadiene levels. Because the data for formaldehyde and acetaldehyde are based on a small data set for Fremont, comparisons and conclusions cannot be made. What should be noted about formaldehyde and acetaldehyde is that, while they can be directly emitted into the air, they can also be formed when other air pollutants chemically react in the atmosphere. This makes it difficult to identify the origin of these two pollutants impacting each monitoring site.

Limit of detection
The lowest concentration of a substance that can reliably measured.

In addition to increased potential cancer risk, breathing these four pollutants can cause non-cancer health effects:

- 1,3-butadiene can cause neurological effects such as blurred vision, fatigue, headaches, and vertigo at very high levels,
- Benzene can cause central nervous system depression; and
- Acetaldehyde and formaldehyde can irritate the eyes, skin, and respiratory tract.

Nanogram
One billionth of a gram

These non-cancer health effects occur at much higher concentrations of these air pollutants than were observed in this study. Formaldehyde can be an irritant for individuals at levels over 2 parts per billion (ppb). The average formaldehyde level measured at Fruitvale during the study was 2.0 ppb, which indicates that some individuals might experience mild irritation during peak exposures. However, this average is below the statewide average of formaldehyde, which was 3.4 ppb in 2002. Formaldehyde is the only toxic air pollutant for which routine air monitoring has shown that measured levels consistently above the levels for which any non-cancer health effects might occur.

Emissions of all four of these pollutants have been reduced in California through a combination of aggressive regulations requiring motor vehicle emission controls and gasoline vapor recovery systems. From 1990 to 2000, outdoor statewide levels declined 53 percent for 1,3-butadiene and 72 percent for benzene. Data for acetaldehyde and formaldehyde are more variable, but levels have decreased significantly since 1990. The ARB has regulations in place to further reduce emissions for all four pollutants.

Perchloroethylene

Levels of perchloroethylene, a persistent organic pollutant, were similar at Fruitvale and Fremont sites. Perchloroethylene can irritate the eyes and respiratory tract, and can also depress the central nervous system. Industrial

processes and dry cleaners are the major sources of emissions of perchloroethylene and other chlorinated pollutants. ARB's control measures on dry cleaning facilities have helped to reduce levels of perchloroethylene statewide, but more needs to be done. Statewide outdoor perchloroethylene levels in 2000 were approximately 58 percent lower than 1990 levels. Controls on degreasers used for automotive maintenance and repairing that are already in place should further reduce levels of this pollutant.

You can locate ARB's ATCM for emissions of perchloroethylene from Dry Cleaning Operations at: (http://www.arb.ca.gov/toxics/atcm/percatcm.htm)

You can locate all of ARB's Automotive Maintenance and Repair ATCM activities at: (http://www.arb.ca.gov/toxics/amr/amr.htm)

Carbon Tetrachloride

Average levels of carbon tetrachloride in Fruitvale were comparable to those measured at the Fremont site. Carbon tetrachloride was the third highest calculated health risk at the Fruitvale site, and fourth highest at the Fremont site. Overall, carbon tetrachloride emissions are very low and are relatively constant throughout California. In fact, carbon tetrachloride levels are fairly constant around the globe, the lingering effect of past use. Carbon tetrachloride takes about 50 years to break down in the atmosphere.

Hexavalent Chromium

The amount of hexavalent chromium in most samples collected at the Fruitvale site was too low to be measured by laboratory instruments. From November 2001 through April 2003 only 7 of the 83 samples from Fruitvale measured values above the limit of detection, with a maximum of 0.54 ng/m3. Hexavalent chromium matching days were not provided since there were missing monitoring data at Fremont for comparison for the whole time period except for one data point. Because hexavalent chromium is highly toxic, even minute amounts still pose a health risk. To reduce this risk, California adopted a control measure in 1988 to reduce emissions of hexavalent chromium from chrome plating. As a result, statewide levels have been reduced.

You can locate all of ARB's hexavalent chromium ATCM activities at: (http://www.arb.ca.gov/toxics/ATCM/chroatcm.htm)

Seasonal Variations

Many pollutants showed seasonal variations. For example, benzene and 1,3-butadiene were higher in the winter than in the summer. This seasonal pattern

is common because the air tends to be more stagnant with less mixing in the winter months, allowing pollutants to accumulate.

Air Monitoring Results for Other Toxic Air Pollutants

In addition to the criteria and toxic air pollutants discussed above, other air pollutants related to industrial sources near Fruitvale were measured as part of this study. These pollutants were either measured at very low levels or were below the levels of detection.

Metals

Several metals, including manganese, nickel, and lead, were higher in Fruitvale than in Fremont. However, the measured levels of these metals are not high enough to pose a significant health risk. For instance, while average levels of manganese at Fruitvale were 19 ng/m^3, the threshold above which there are some health concerns is 200 ng/m^3. Sources of these metals include industrial and commercial operations as well as motor vehicles.

Levels of arsenic in Fruitvale were comparable to other sites and to average statewide levels. Observed levels did not pose a significant health risk. While average levels of arsenic in Fruitvale were 1.4 ng/m^3, the threshold above which there are some health concerns is 30 ng/m^3. The primary industrial sources of arsenic in California are electrical services and metal mining. Arsenic is also used in insecticides, weed killers, fungicide, and as a wood preservative.

Para-dichlorobenzene and Methylene Chloride

The average levels of para-dichlorobenzene and methylene chloride were similar between Fruitvale and Fremont. Para-dichlorobenzene is used as a room deodorant, in mothballs, and is a registered insecticide. Methylene chloride is used as a solvent, as a cleaning agent in plastic manufacturing and as a paint stripper. ARB is currently working on air toxic control measures to reduce the emissions of para-dichlorobenzene in California.

You can locate all of ARB's proposed ATCM for para-dichlorobenzene activities at: (http://www.arb.ca.gov/regact/conprod/execsum.pdf)

Monitoring Results for Elemental Carbon

Elemental carbon is a material found in particulate matter (PM_{10}). In the past, it has been used as an indicator of, or surrogate for, diesel particulate matter (diesel PM) levels because of the relatively high content of elemental carbon in diesel. Because diesel PM emissions are of major concern in Fruitvale, elemental

carbon was monitored in this study. Fruitvale had 6 of 71 samples above the level of detection with a maximum value of 3 ug/m^3. Elemental carbon consists of tiny, black, solid particles of soot, most of which are smaller than 2.5 microns. This small size allows the particles to reach deep into the lungs where they may be deposited and result in adverse health effects.

Recently, however, diesel technologies have improved and the diesel fleet has become cleaner. Other combustion processes such as fireplaces, cooking, forest fires, gasoline engines, agricultural burning, and power plants also emit elemental carbon. As emissions from the diesel fleet have decreased, these sources now account for a larger percentage of total elemental carbon in the air. With these changes, elemental carbon alone is no longer a good marker for diesel PM.

Elemental carbon is not routinely monitored, and there are no standards or thresholds established for which levels of elemental carbon are deemed unsafe. ARB used the U.S. EPA-approved method to measure elemental carbon in this study. However, earlier studies have used different analysis methods, so there are no historical regional or statewide values available for comparison.

Conclusions

The Lockwood Elementary School monitoring site in Fruitvale was chosen to fulfill the Children's Environmental Health Protection Act's requirement to look at the impact of motor vehicle emissions and industrial sources from transportation-related emission sources on locations where children live, learn, and play. Based on outdoor air measurements collected in Fruitvale along with data from the long-term monitoring sites in Fremont and Oakland, ARB staff found the following patterns in the air quality data.

Average levels of criteria air pollutants in Fruitvale are comparable to measurements from the nearest long-term monitoring sites in the Bay Area. Fruitvale, like many other areas in the Bay Area, exceeds the State standard for PM_{10}. The State PM_{10} standard (50 µg/m^3) was exceeded at both Fruitvale and the Fremont site on December 4, 2002. The second exceedance recorded at Fruitvale was measured on November 28, 2002, which was Thanksgiving Day. This suggests that something out of the ordinary happened that day such as a large amount of people using their fireplaces, or some other unusual condition. While the State PM_{10} standard was exceeded two times at the Fruitvale site, maximum PM_{10} levels at more distant monitoring sites in the San Francisco Bay Area region can be higher. All of the PM2.5 monitoring data collected in the Fruitvale study were

invalidated due to an instrument problem. Programs are in place for reducing the levels of particulate matter.

Fruitvale, like many other areas in the Bay Area, didn't exceed the State standards for CO. The Fruitvale site didn't exceed any of the State ozone standards. The Fremont site did exceed the State one-hour ozone standard on three occasions. The State NO_2 standard was not exceeded during the study.

Cancer Risk

The potential inhalation cancer risk value in Fruitvale, based on the eight key air pollutants measured, is higher than the cancer risk calculated for the nearby long-term monitoring site in Fremont. In addition, cancer risk in Fruitvale is similar to the risk calculated for the statewide average. Based on the information collected in this study, the estimated cancer risk associated with toxic air pollutants (not including diesel particulate) in Fruitvale is 180 excess cases of cancer per million people exposed. This is higher than the estimated toxic air pollutant cancer risk of 160 in a million in Fremont, and is similar to the statewide urban average toxic air pollutant risk of 181 in a million. The estimated potential cancer risk represents the chances in a million of developing cancer due to breathing toxic air pollutants. Currently, there is no accepted method for measuring diesel particulates in the air. As a result, estimates from this study do not include risk from diesel particulate.

Benzene and 1,3-butadiene, the main toxic pollutants associated with cancer risk in these areas, account for most of the calculated cancer risk in Fruitvale and Fremont. Levels of benzene and 1,3 butadiene were higher at Fruitvale, than what was measured at the Fremont site. Since motor vehicles are the primary source of both pollutants, heavy traffic near Fruitvale is probably the cause of the higher benzene and 1,3 butadiene levels. Cancer risk estimates in this report did not include diesel PM.

Reducing Air Pollution in Fruitvale

There are numerous programs that specifically target mobile source emissions such as those found in Fruitvale. The ARB is responsible for developing statewide programs and strategies to reduce the emission of smog-forming pollutants and toxics by mobile sources. The ARB has programs such as the Diesel Risk Reduction Program, and the California Motor Vehicle Program that help reduce air pollution from motor vehicles.

The ARB's Diesel Risk Reduction Program reduces diesel emissions from both new and existing diesel engines and vehicles. One of the key elements of the plan

is to retrofit existing diesel engines in California to reduce diesel particulate emissions to near zero, in the shortest time possible. The program focuses on several control options such as the catalyst-based diesel particulate filters or traps and other viable alternative technologies and fuels.

You can find more information about the Diesel Risk Reduction Plan at:

(http://www.arb.ca.gov/diesel/documents/rrpapp.htm)

The ARB also has a website that lists information on all mobile source related programs. You can find more information about these programs at:

(http://www.arb.ca.gov/msprog/msprog.htm)

The ARB will continue to evaluate the health effects of pollutants in the air while implementing programs with local authorities that aim at reducing levels of air pollution in communities such as Fruitvale.

For more information, contact:

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The California Air Resources Board is a part of the California Environmental Protection Agency.

The Mission of the California Air Resources Board

"To promote and protect public health, welfare, and ecological resources through the effective and efficient reduction of air pollutants while recognizing and considering the effects on the economy of the State".